

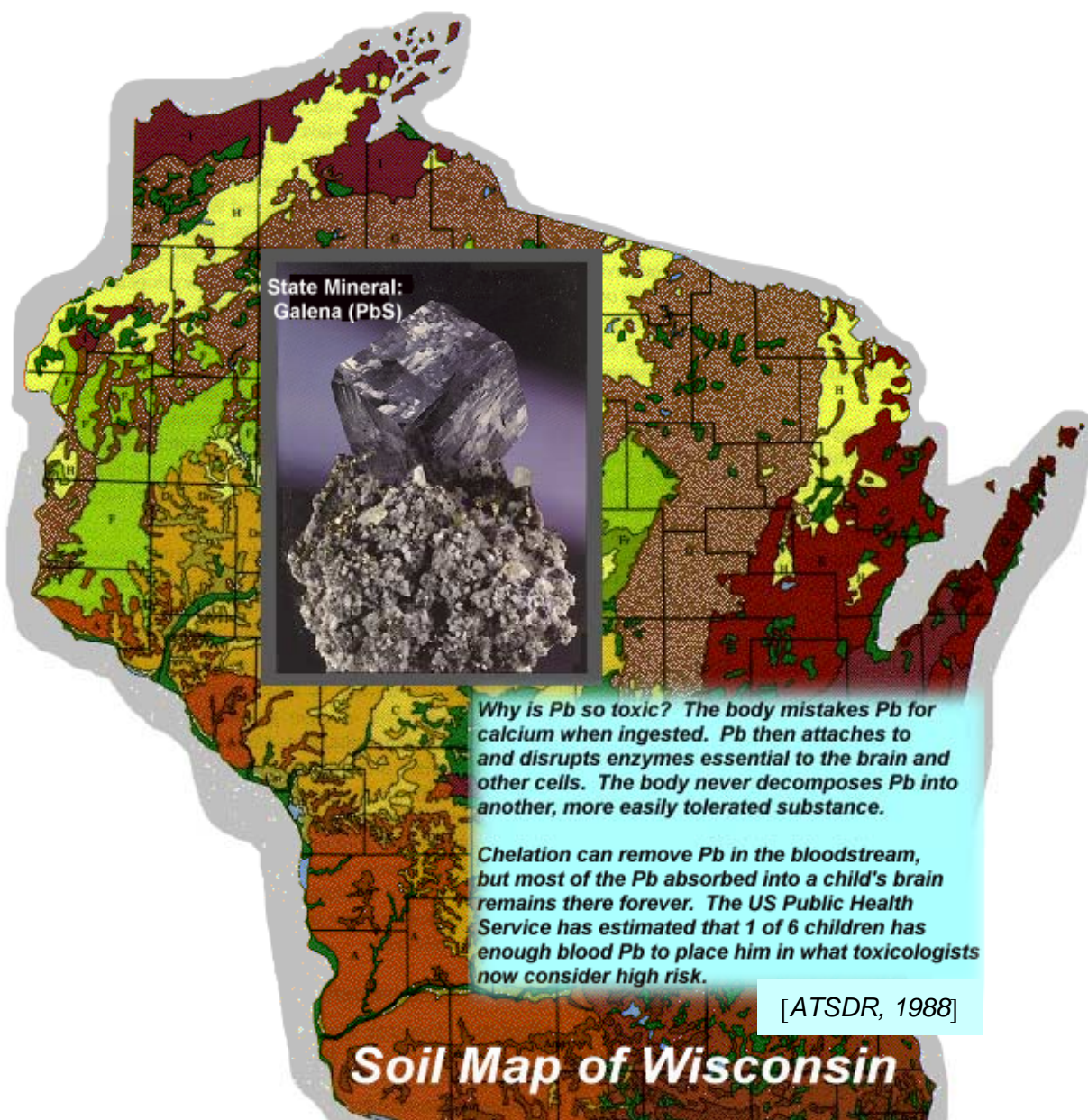
Remediation and Redevelopment Program

RR Guidance

Commonly Asked Questions About the Lead (Pb) Soil Standards in Wisconsin

PUB-RR-653

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PURPOSE

This guidance is intended for Department of Natural Resources staff and for the public in understanding and applying the rules, specifically NR 720, Wis. Adm. Code, that apply to the cleanup of soil lead contamination. It is intended to answer some commonly asked questions regarding lead in soil and, in the process, clarify several issues in remediating sites with lead contamination. This guidance does not contain mandatory requirements except where requirements found in statute or administrative rule are referenced.

Disclaimer: *This document is intended solely as guidance and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any part in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.*

GUIDANCE REVISIONS

This guidance will be updated as needed. Comments and concerns may be sent to “Guidance Revisions”, Ed Lynch - RR/3, WDNR, P.O. Box 7921, Madison, WI 53707, phone number (608) 266-3084, internet e-mail lynche@dnr.state.wi.us.

COMMONLY ASKED QUESTIONS ABOUT THE LEAD (Pb) SOIL STANDARDS IN WISCONSIN

1) Why is the NR 720 (Soil Cleanup Standards) residential Table 2 residual contaminant level (RCL) for lead (50-ppm Pb) different than the Department of Health and Family Services' original level of 250 ppm?

Nearly a decade ago – when the levels currently in *Table 2* of NR 720 (direct-contact residual contaminant levels) were being developed – the Department of Health and Family Services (DHFS) and the Department of Natural Resources (DNR) had jointly determined a level in soil of 250-ppm Pb to be protective of children in Wisconsin. Because of the presumption in NR 720 that multiple contaminants may be present, and that contaminants may be coming from multiple sources, a 20% safety factor was applied to this soil Pb level. This 20% safety factor was applied not just to Pb, but to all the residential non-carcinogenic RCLs listed in NR 720 *Table 2*. Hence, the 250 ppm of soil Pb was reduced to 50 ppm (0.2×250 ppm), as listed in the table. The safety factor amounts to applying a hazard quotient of 0.2 in a residential setting, and it was intended to be analogous with the non-carcinogen preventive action limits in ch. NR 140.¹

2) Does NR 720 currently allow for a residential Pb direct-contact RCL of 250 ppm?

Yes, *but only if* Pb is the ONLY contaminant at a site. NR 720 allows for a maximum cumulative hazard index² of 1, yet because of the presumption that multiple contaminants and sources may be present, only 20% of the "safe" level was tabulated in the residential RCL in NR 720 *Table 2*. If Pb is the only contaminant, then a residential site can have as much as five times the *Table 2* RCL (5×50 ppm = 250 ppm), the original level found by DHFS and DNR to be protective of children in Wisconsin.

3) How does the 250-ppm Pb residential RCL allowed under NR 720 compare with US EPA's 400-ppm Pb in soil for the protection of human health?

The 250-ppm Pb RCL that was jointly determined by DNR and DHFS preceded EPA's 400-ppm Pb soil screening level. These two different soil Pb levels have different regulatory purposes. Currently, the 250-ppm soil Pb is a DNR-acceptable default soil cleanup level allowed under NR 720, Wis. Adm. Code, when no other contaminant is present at a residential site. On the other hand, the 400-ppm Pb in soil is not a soil cleanup level, but rather it is an EPA soil screening level (SSL) which, if exceeded, may necessitate federal attention [*US EPA, 1996a*]. Cleanup levels set by the EPA are

¹ See Note under NR 720.11 (3) (b).

² See NR 720.11 (3) (a).

determined on a case-by-case basis. At a Superfund site cleanup, for instance, the state-promulgated requirements, unless waived, must be met; as such, the requirements in ch. NR 720 would apply to Superfund sites.

Appendix A explains how the integrated exposure uptake biokinetic model (IEUBK) was applied by the EPA to determine the SSL of 400-ppm Pb. The Appendix further discusses the IEUBK model result when the Wisconsin non-industrial RCL of 250-ppm Pb is used instead.

4) *The federal EPA Toxic Substances Control Act rule (40 CFR Part 745, http://www.epa.gov/lead/403_final.pdf, January 2001) allows Pb levels of 1,200 ppm in bare soils at a residential yard where children are not expected to play. Does this affect the residential RCL in NR 720, Wis. Adm. Code?*

No, the federal TSCA standard does **not** affect the state residential RCL for Pb. The 400-ppm Pb and 1,200-ppm Pb are federal (but not state) residential soil-Pb hazard standards in the play areas and nonplay areas, respectively. Notwithstanding these standards, the federal rule encourages States to adopt more stringent standards if circumstances warrant such action (see p. 1208, *Federal Register*, Vol. 66, No. 4, Friday, January 5, 2001). The EPA's 400-ppm Pb level hinged on the IEUBK model, but the EPA used another model, one that stemmed from an empirical cost-benefit analysis, to establish the higher 1,200-ppm soil-Pb level. (Appendix A discusses how this higher level in soil infringes on the IEUBK risk constraints that EPA used to establish the 400-ppm Pb level.) The higher 1,200-ppm standard is consistent with EPA's "worst first" approach to steer resources to "situations that present clearer, more certain risk." However, under NR 720, Wis. Adm. Code, a cost-benefit balancing is **not** the determining factor for either generic or site-specific RCLs. So clearly, the (priority) objective of and (cost) basis in the TSCA rule leading to the 1,200-ppm Pb standard are precepts that do not operate in determining generic RCLs.

5) *Can a site-specific Pb soil RCL be determined in compliance with NR 720?*

Yes, and this can be accomplished by one or a combination of the following procedures:

- (1) Establish a background soil concentration level using an appropriate DNR-approved method.³
- (2) Use the synthetic precipitation leaching procedure (SPLP) test results to determine an RCL for the protection of groundwater quality (PUB-RR-523).

³ See NR 720.11(5).

- (3) Collect sufficient site-specific parameters (diet uptake, drinking water Pb content, blood-Pb data and its distribution, etc.) to be able to confidently use the IEUBK as well as the Risk-Based Remediation Goal (RBRG) models.
- (4) Use performance standards to reduce risk of Pb exposure or Pb leaching into the groundwater.⁴ An engineering control may be selected even though the soil contamination exceeds the RCL determined from the previous three procedures.

All of the above methods would require the collection of more data related to the site and site conditions. Moreover, there are potential drawbacks to each of the above procedures, examples of which are the following:

- (1) To establish an RCL based on background, DNR approval of an appropriate sampling plan is required. The use of site background Pb level may necessitate cleanup to lower than the default 250-ppm non-industrial RCL and 500-ppm industrial RCL, because natural Pb levels in surface soil are usually below 50 ppm [e.g., *Reagan and Silbergeld, 1990*].
- (2) The theoretical minimum Pb in soil for the SPLP to pass groundwater contamination potential criterion (i.e., SPLP leachate is less than NR 140 PAL of 1.5 ug/l) is only 0.03 ppm.⁵
- (3) For the IEUBK model, any increases in non-soil Pb contribution (e.g., if drinking water Pb > 4 ug/l) may result in lower soil Pb allowed in the model. Additional guidelines on using the IEUBK model are available from the US EPA [1999] and the Appendix to this guidance can help in understanding the output from the program. For industrial sites (no exposure for children), the RBRG model may be appropriate, but site data gathering (especially on blood-Pb) may prove difficult.
- (4) A performance standard for Pb cleanup will usually involve an engineered remedy to prevent direct-contact exposure, or leaching to groundwater. A public notice of performance standard is required⁶ and a maintenance agreement/deed restriction may be required for its long-term maintenance.

⁴ See NR 720.19(2).

⁵ If the SPLP leachate is to be at Pb's NR 140 ES of 15 ug/l, the theoretical minimum would be 0.3-ppm Pb in soil.

⁶ See NR 714.07(5).

6) Why were Pb-specific models (i.e. IEUBK, RBRG) developed by the EPA to determine Pb levels protective of human health?

Lead is different from other toxicants because, as has been recognized more than a century ago, its health effects in humans are well understood and documented. Note, for instance, that the federal maximum contaminant level goal (MCLG) for Pb in tap and drinking water is zero (0) because of EPA's conclusion that deleterious health effects "may occur at levels so low as to be essentially without a threshold" [US EPA, 1998]. Lead does not have an oral reference dose, or a level that, when ingested, would not have any adverse health effects. Having no reference dose⁷ for Pb that is deemed protective of human health, we can not simply apply the standard risk-based algorithm to estimate a contaminant's level in soil. Hence, different Pb models have been developed to determine safe Pb levels in soil.

Non-industrial site. Summaries of studies by the Center for Disease Control (CDC) studies [e.g., Schilling and Bain, 1989; US DHHS, 1992] showed a significant correlation between children's blood-Pb levels and household-specific soil-Pb levels. However, the data do not show a linear relation between blood-Pb and soil-Pb levels. For instance, simple empirical relation [e.g., Schilling and Bain, 1989] shows that in order to reduce children's blood Pb level by 50%, a reduction of more than 90% in the soil Pb level is necessary. This non-linearity between soil-Pb and blood-Pb is interpreted as evidence that soil is not the sole source of blood-Pb in most cases. For this reason, the EPA developed an integrated exposure uptake biokinetic, or IEUBK, model to account for several other Pb pathways when children are at risk.

Industrial site. A separate model has been developed when adults are at risk from exposure to Pb [e.g., Bowers et al., 1994]. The risk for adults includes an increased incidence of spontaneous abortions and stillbirths that had been reported as early as 1860 among pregnant women who manifested clinical Pb poisoning symptoms. EPA has developed an algorithm, termed here as risk-based remediation goal (RBRG), which uses, as a basis, risk to women of child-bearing age [US EPA, 1996]. The RBRG model⁸ could presumably be applied to industrial sites where children are not a concern. A hindrance to the RBRG model is that it requires site-specific adult blood-Pb levels. This type of

⁷ As an exercise, let's say that we "back-calculate" an oral reference dose (RfDo) for inorganic Pb. When given the default NR 720 industrial exposure assumptions and the industrial RCL of 500 ppm, Pb's RfDo would be 0.0005 mg/kg-d, comparable to the RfDo's of some of the most potent pesticides (e.g., DDT, heptachlor) that are now banned for use, thus underscoring the toxic effects of Pb.

⁸ For reference, the following inputs to the RBRG model would result in the 500-ppm soil Pb RCL: a baseline blood-Pb of 3.1 ug/dl, a geometric standard deviation of 2.1, an ingestion rate of only 50 mg/d, and an exposure frequency of only 50 d/yr. An increase in any of these parameters in the RBRG model (e.g., when NR 720 default exposure assumptions are used, such as adult ingestion rate of 100 mg/d and exposure frequency of 250 d/yr) would result in site-specific industrial RCLs LESS than the NR 720 industrial default RCL of 500-ppm soil Pb.

data is not usually collected at contaminated sites in Wisconsin. Furthermore, this model is still under scrutiny because it can potentially misrepresent actual site conditions. For instance, other researchers have found blood pressure as the most sensitive adult endpoint for deriving a soil-Pb target level [e.g. *US EPA, 1990; Stern, 1996*]. Since Pb exposure increases an adult's blood pressure, it increases his risk of a heart disease, stroke or heart attack. This cause/effect relation is left out of the RBRG model.

7) *At what depths should the direct-contact Pb level be applicable?*

The upper two inches (2") of undisturbed soil can retain most of the Pb deposited from the air [*EPA, 1986*]. As such, include, in the protocol for sampling, the topmost two inches (2") of soil, excluding surface debris and leafy vegetation, but including decomposing litter. Then collect deeper samples from two to six inches (2"-6") separately, then additional samples from six inches (6") and deeper. The DNR's Remediation and Redevelopment program generally recommends evaluating direct-contact risk in soil down to a depth of four feet, so extend the sampling for Pb in soil to at least this depth, perhaps in the intervals of 0-2, 2-6, 6-12, 12-24, and 24-48 inches.

8) *How do we use NR 720 Table 2 RCLs to develop site-specific soil residual contaminant levels (SSRCL) when Pb is present together with other contaminants?*

The answer to this question is best illustrated through examples. The basis for the examples below is the concept of the target hazard quotient (THQ) and target cancer risk (TCR) under NR 720. Specifically, NR 720.19(5)(a), Wis. Adm. Code, puts constraints on the cumulative hazard index and excess cancer risk when determining SSRCLs. These constraints are as follows:

- (1) For non-carcinogens (NCs):

$$\sum_{i=1}^{All\ NCs} (THQ)_i \leq 1$$

where: $(THQ)_i = \text{Target Hazard Quotient for the } i^{th} \text{ non-carcinogen}$

- (2) For carcinogens (Cs), there are two (2) constraints for *in-situ* soils:

$$(TCR)_j \leq 10^{-6} \quad ; \quad \sum_{j=1}^{All\ Cs} (TCR)_j \leq 10^{-5}$$

where: $(TCR)_j = \text{Target Cancer Risk for the } j^{th} \text{ carcinogen.}$

When Pb is present at a site together with the contaminants that are listed under NR720 *Table 2* – reproduced below for reference in the examples – then the levels listed in the table can be scaled to determine SSRCLs *after* apportioning target hazard quotients and target cancer risks to the different contaminants of concern at the site. When this is done, the resulting SSRCLs would be consistent with the above constraints and with the default exposure assumptions in NR 720.19(5)(c).

NR 720 *Table 2* Direct Contact RCLs Related to Land Use

	Non-Industrial (mg/kg)	Industrial (mg/kg)	Basis
Arsenic (As)	0.039	1.6	Cancer
Cadmium (Cd)	8.	510.	Noncancer
Chromium, hexavalent (hex Cr)	14.	200.	Cancer
Chromium, trivalent (tri Cr)	16,000.	NA	Noncancer
Lead (Pb)	50.	500.	Noncancer

Example 1. Site has *ONLY* two (2) contaminants of concern in the soil: Pb and Cd (both assumed as non-carcinogens). Let's determine site-specific residual contaminant levels (SSRCL) protective of direct contact.

Non-Industrial Setting	Industrial Setting
<p>1. Apportion Target Hazard Quotients:</p> $\begin{array}{l} \text{THQ}_{\text{Pb}} = 0.5 \\ \text{THQ}_{\text{Cd}} = 0.5 \\ \hline \Sigma \text{THQ} = 1.0 \end{array}$ <p>2. Calculate Noncancer basis SSRCL:</p> $\text{SSRCL}_i = (\text{Table 2 RCL}_i) \times (\text{THQ}_i) / 0.2$ <p>(Note: Table 2 non-industrial RCLs were individually determined using 0.2 for a THQ.)</p> <p>→ $\text{SSRCL}_{\text{Pb}} = (50 \text{ mg/kg}) \times \text{THQ}_{\text{Pb}} / 0.2 = 125. \text{ mg/kg}$</p> <p>→ $\text{SSRCL}_{\text{Cd}} = (8 \text{ mg/kg}) \times \text{THQ}_{\text{Cd}} / 0.2 = 20. \text{ mg/kg}$</p>	<p>1. Apportion Target Hazard Quotients:</p> $\begin{array}{l} \text{THQ}_{\text{Pb}} = 0.5 \\ \text{THQ}_{\text{Cd}} = 0.5 \\ \hline \Sigma \text{THQ} = 1.0 \end{array}$ <p>2. Calculate Noncancer basis SSRCL:</p> $\text{SSRCL}_i = (\text{Table 2 RCL}_i) \times (\text{THQ}_i) / 1.0$ <p>(Note: Table 2 industrial RCLs were individually determined using 1.0 for a THQ.)</p> <p>→ $\text{SSRCL}_{\text{Pb}} = (500 \text{ mg/kg}) \times \text{THQ}_{\text{Pb}} / 1.0 = 250. \text{ mg/kg}$</p> <p>→ $\text{SSRCL}_{\text{Cd}} = (510 \text{ mg/kg}) \times \text{THQ}_{\text{Cd}} / 1.0 = 255. \text{ mg/kg}$</p>

Example 2. Site has *ONLY* two (2) contaminants of concern in the soil: Pb (non-carcinogen) and As (carcinogen). Let's determine site-specific residual contaminant levels (SSRCL) protective of direct contact.

Non-Industrial Setting	Industrial Setting
<p>1. Apportion THQ and TCR:</p> <p>THQ_{Pb} = 1.0 (maximum allowed under NR 720) TCR_{As} = 10⁻⁶ (maximum allowed under NR 720)</p> <p>2. Calculate Noncancer basis SSRCL for Pb:</p> $SSRCL_i = (Table\ 2\ RCL_i) \times (THQ_i) / 0.2$ <p>(Note: Table 2 non-industrial RCLs were individually determined using 0.2 for a THQ.)</p> <p>→ SSRCL_{Pb} = (50 mg/kg) × THQ_{Pb} / 0.2 = 250. mg/kg</p> <p>3. Calculate Cancer basis SSRCL for As:</p> $SSRCL_j = (Table\ 2\ RCL_j) \times (TCR_j) / 10^{-7}$ <p>(Note: Table 2 residential RCLs were individually determined using 10⁻⁷ for a TCR.)</p> <p>→ SSRCL_{As} = (0.04 mg/kg) × TCR_{As} / 10⁻⁷ = 0.4 mg/kg</p>	<p>1. Apportion THQ and TCR:</p> <p>THQ_{Pb} = 1.0 (maximum allowed under NR 720) TCR_{As} = 10⁻⁶ (maximum allowed under NR 720)</p> <p>2. Calculate Noncancer basis SSRCL for Pb:</p> $SSRCL_i = (Table\ 2\ RCL_i) \times (THQ_i) / 1.0$ <p>(Note: Table 2 industrial RCLs were individually determined using 1.0 for a THQ.)</p> <p>→ SSRCL_{Pb} = (500 mg/kg) × THQ_{Pb} / 1.0 = 500. mg/kg</p> <p>3. Calculate Cancer basis SSRCL for As:</p> $SSRCL_j = (Table\ 2\ RCL_j) \times (TCR_j) / 10^{-6}$ <p>(Note: Table 2 industrial RCLs were individually determined using 10⁻⁶ for a TCR.)</p> <p>→ SSRCL_{As} = (1.6 mg/kg) × TCR_{As} / 10⁻⁶ = 1.6 mg/kg</p>

The procedure to determine generic *direct-contact* RCLs for compounds not in Table 2 of NR 720 is outlined in the DNR guidance on “Soil Cleanup Levels for Polycyclic Aromatic Hydrocarbons (PAHs)” [WDNR, 1997]. This procedure to determine direct-contact RCLs is the same as that outlined in the US EPA Soil Screening Guidance [US EPA, 1996a], with the exception that the default exposure assumptions under NR720.19(5)(c) are used instead of the US EPA defaults. Briefly, for a specific chemical, pathway-dependent (i.e., ingestion, inhalation and dermal contact) RCLs are first determined for both the cancer and non-cancer endpoints; the least (i.e., most protective of human health risk) of these RCLs becomes the generic RCL. Then from these generic RCLs, SSRCLs can be determined so as to keep the hazard quotient and cumulative risk below the limits under NR 720.19(5)(a) as shown in the above examples.⁹

⁹ Caution, however, must be used especially where several contaminants are present (for example, petroleum) because soil contaminant levels indicating free product may be triggered before the risk-based levels; in this case, the free-product indicator levels become the direct-contact SSRCLs.

9) What is the Appendix to this guidance for?

The Appendix gives a short discussion of the IEUBK model, and presents a brief explanation on how to interpret the output from the model. One critical input in the IEUBK model is the Pb level in drinking water. EPA assumed the Pb level in drinking water to be 4 ug/l in determining the 400-ppm Pb soil screening level. The Appendix has a map showing counties in Wisconsin where potable well samples had shown levels of Pb exceeding 4 ug/l. The map also shows the counties where the NR 140 groundwater enforcement standard (ES) of 15 ug/l is exceeded. The map is based on the result of a query on samples from potable wells included in a WDNR database. The Appendix also points to a useful DNR website where the groundwater and drinking water database can be queried via the internet.

10) Who do I call for additional questions?

For more information, or if you have additional questions, you may contact Resty Pelayo at (608) 267-3539.

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U.S. EPA IRIS Substance file, *Lead and compounds (inorganic)*,
<http://www.epa.gov/iris/subst/0277.htm>, last updated May 5, 1998.

** U.S. EPA, *Soil Screening Guidance: Technical Background Document*, EPA/540/R-95/128, May 1996a. See also: http://risk.lsd.ornl.gov/calc_start.htm (Note: This website will provide an interface to calculate EPA SSLs using generic equations/assumptions; however, if you pick Lead, you'll not get any answer!)

U.S. EPA, Technical Review Workgroup for Lead, *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil*, December 1996b.

U.S. EPA, *The IEUBK*, <http://www.epa.gov/superfund/programs/lead/ieubk.htm>, last updated January 6, 1999.

W.D.N.R., *Soil Cleanup Levels for Polycyclic Aromatic Hydrocarbons (PAHs)*, Interim Guidance, Bureau for Remediation and Redevelopment, PUB-RR-519, April 1997.

** Wixson, B.G., and B.E. Davies, *Lead in Soil, Recommended Guidelines*, Copyright Science Reviews, Northwood, 132 pp., 1993.

** - Recommended.

Appendix A

Understanding the IEUBK Model Results

The discussion in this Appendix may be of interest and use to someone who wishes to use the IEUBK model and understand the output from the model. The IEUBK model is short for the integrated exposure uptake biokinetic model [US EPA, 1999] used by the US EPA in its adoption of a residential soil screening level (SSL) of 400 ppm for Pb. Since Pb is an insidious pollutant, Pb exposure can come, not just from contaminated soil, but also from other non-soil sources, such as drinking water, air and diet. When given the exposure and contribution from a multitude of Pb sources, the IEUBK model would predict children's blood-Pb (PbB) expressed in units of micrograms per deciliter (ug/dl). To interpret the PbB result, we need to know what the "permissible" PbB level is. The PbB level assumed by the US EPA is the CDC [1991] intervention level of 10 ug/dl PbB, with the additional caveat that no more than 5% of children would have PbB higher than this level. A short list of "default" assumptions the US EPA used in the IEUBK model is as follows:

- 1.) The 95th percentile of the blood-Pb (PbB_{0.95}) is 10 ug/dl.
- 2.) Children's blood-Pb (PbB) levels are log-normally distributed with a geometric standard deviation (GSD) 1.6 in the PbB distribution.
- 3.) Non-soil Pb contributions are from national averages (e.g., 4 ug/l Pb in drinking water, 0.1 ug/m³ Pb in air, 5.5 to 7 ug/d in children's diet, etc.).

The blood-Pb (PbB) result from the IEUBK model is interpreted to be a geometric mean. What would be the desired geometric mean of the PbB level? With the first two of the above assumptions, the limiting geometric mean of the blood-Pb (PbB_{GM}) can be determined by:

$$PbB_{GM} = \frac{PbB_{0.95}}{GSD^{1.645}} = \frac{10 \text{ ug / dl}}{1.6^{1.645}} = 4.6 \text{ ug / dl}$$

The factor 1.645 in the above equation is the "z-value" from a statistical table of the standard normal cumulative distribution when the probability is 0.95 (or 95%). When the resulting PbB from an IEUBK "run" is at or below this PbB_{GM} of 4.6 ug/dl, then the expectation is that Pb exposure is not a problem. When only two significant figures from the statistical table are used (i.e., exponential factor used is 1.6, rather than 1.645), then the PbB_{GM} constraint is "stretched" to 4.7 ug/dl. So when the resulting PbB is over 4.7 ug/dl, then Pb exposure is a problem¹⁰; otherwise, it is not.

¹⁰ Note that this is NOT a conservative assumption. By comparison, the average blood-Pb level in (young and adult) Americans is today only 2.3 ug/dl [CDC, 1997], underscoring the higher risk allowed for children in the default IEUBK model.

How was the 400-ppm SSL for Pb determined? Using the PbB_{GM} of 4.7 ug/dl for children aged 0 to 6 years as constraint, and “back-calculating” the necessary soil input, the resulting soil Pb level is the EPA’s SSL of 400 ppm. Actually, the IEUBK model gives a soil Pb level closer to 350 ppm. However, the $350 = 3.5 \times 10^2$ is rounded off to only one significant figure or to $4 \times 10^2 = 400$ ppm. This is important to note because if a straight value of 400-ppm soil Pb is used together with the other default inputs to the model, the resulting PbB is 5.1 ug/dl, or over the PbB_{GM} constraint of 4.7 ug/dl. When there is 1,200 ppm Pb in soil, the IEUBK model predicts a PbB_{GM} of 8 to 11 ug/dl, or from 30% to 60% of children having a blood-Pb level exceeding 10 ug/dl (see p. 1224, *Federal Register*, Vol. 66, No. 4, Friday, January 5, 2001). When there is 1,200 ppm Pb in soil, the IEUBK model indicates more children would be at risk, and the constraint of not more than 5% of children exceeding a blood-Pb of 10 ug/dl is not met. Clearly, the IEUBK model, which was used to establish the 400-ppm Pb hazard standard, was **not** what EPA used to come up with the 1,200 ppm Pb soil hazard level for non-play areas at a residential yard. Rather, EPA invoked **another** model. EPA relied on an empirical cost-benefit analysis model to determine a hazard standard of 1,200 ppm Pb in soil. One major consideration in EPA’s decision about the 1,200 ppm soil hazard standard is EPA’s estimate that 4.7 million homes would exceed the standard, much less than EPA’s estimate of over 12 million homes that would exceed a 400 ppm yard-wide standard.

What about when Wisconsin’s RCL of 250-ppm Pb is used in the IEUBK model? When 250-ppm (rather than 350 or 400-ppm) Pb in soil is used together with an otherwise same set of inputs as EPA’s, the IEUBK model predicts the PbB level for children 0 to 6 years to be 3.8 ug/dl, easily passing the PbB_{GM} constraint. Another important consideration in Wisconsin is the non-soil Pb default inputs in the IEUBK model, such as drinking water quality. If instead of 4 ug/l Pb in drinking water, the NR 140 groundwater enforcement standard (ES) of 15 ug/l is used in the IEUBK model, and the soil Pb level is at the RCL of 250 ppm, the resulting PbB would be 4.6 ug/dl. So at these Pb levels (250-ppm Pb in soil *and* 15 ug/l Pb in drinking water), the IEUBK model would still predict that the exposure does not pose a problem, but that the result is close to the limit where we may begin to discern a problem.

Where in Wisconsin may we expect high Pb level in drinking water? Because of the importance of assessing soil Pb cleanups in the context of other Pb sources like drinking water, we include here a summary of a query on Pb levels in potable wells. The query was made on the DNR’s Groundwater Retrieval Network (GRN) database, and the summary provided in the attached table and map. The GRN database has data on Pb dating back to 1975. For additional information on Pb levels in drinking water (not just from potable wells), a good starting point is the DNR’s internet website at <http://www.dnr.state.wi.us/org/water/dwg/dws.htm>. Specific queries can be obtained at this website’s link to the DNR’s database.

Appendix A: Table 1

Lead (Pb) in Wisconsin Groundwater: GRN Query Results on MC, PR and OC Wells¹¹

Short Description of Result: (Date of Query: 3/27/2000)

of Pb analyses: 2,582 (sampling date from 5/1975 to 1/2000). A high of 490 analyses was done in 125 wells in Door county. No data came from the following counties: Iron, Menominee and Pepin.

Typical Pb Reporting Limit before 1/1993: 3.0 ug/l

Typical Pb Detection Limit since 1993: 0.4 ug/l

Summary Table:

	MC	PR	OC
# of Pb Analyses	852	1,519	211
(# of Counties Represented)	(66)	(64)	(38)
# of Wells Sampled	584	756	159
# of Wells where Pb was Detected over 4 ug/l	46	243	18
(# of Counties where wells are located)	(30)	(53)	(11)
# of Wells where Pb ES of 15 ug/l was Exceeded	15	108	8
# of these above-Pb ES wells that are now abandoned	1	7	1
(# of Counties where Pb ES was Exceeded)	(12)	(34)	(7)
Highest Pb Level Found (ug/l)	2,000.	7,200.	1,240.
[Date Sampled]	[6/23/92]	[7/9/93]	[3/10/94]

¹¹ MC = Municipal-Community Wells
PR = Private-Residential Potable Wells
OC = Community, Other than Municipal, Well

Appendix A: Figure 1

Counties with Potable Wells where Pb was Detected over 4 ug/l
(Data set is from WDNR GRN Query dated 3/27/2000)

